



URINARY TRACT INFECTION in children

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UTI

WHY CARE ABOUT UTIs ??

- UTIs

Important risk factor for :
renal insufficiency
renal scarring.
end-stage renal disease

WHY CARE ABOUT UTI ??

- UTI Accounts for almost 1% of office visits to the pediatrician and 5-15% of the ER visits
- renal damage reported in about 5% of children with UTI
- The major cause of CKD & ESRD in children is reflux nephropathy and congenital renal anomalies (CAKUT)

UTI.... INCIDENCE

It is difficult to estimate the true incidence of UTIs in children because many children have only fever with no specific urinary symptoms, and is affected by the method the urine sample is collected.

- Urinary tract infections (UTIs) before 12yr age occur in 5-8% of girls and 2% of boys.
- In girls, the first UTI usually occurs by the age of 5 yr, with peaks during infancy and toilet training.
- In boys, most UTIs occur during the 1st yr of life

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- Male: female ratio :
more common in males in the first year of age then more common in females beyond 1 yr age
 - Recurrence after first UTI :
 - 50-60% of children will develop a second UTI within 1yr.

WHEN TO SUSPECT UTI

CLINICAL MANIFESTATIONS

- ***Pyelonephritis*** :

Present with abdominal or flank pain,
fever,
malaise, nausea, vomiting, and
occasionally diarrhea

this indicates Involvement of the renal parenchyma

CLINICAL MANIFESTATIONS

- ***Cystitis***

Indicates bladder involvement.

Symptoms include dysuria, urgency, frequency, suprapubic pain, incontinence, and malodorous urine.

It does not cause fever and does not result in renal injury.

WHEN TO SUSPECT?

Fever ???

the prevalence of UTI is 5% in children <2yr presenting with fever > 38.0 and no defined focus

- **In newborns and infants**

Nonspecific symptoms such as jaundice, poor feeding, irritability

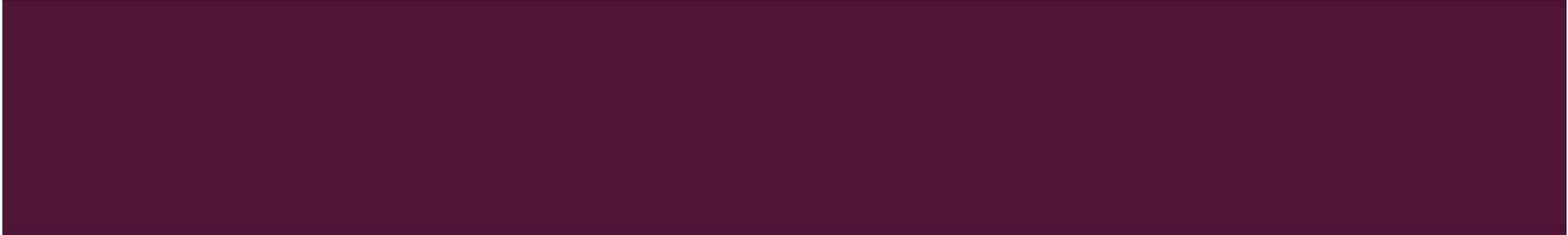
Weight loss/ FTT in recurrent febrile UTI

PATHOGENESIS

- Most UTIs are ascending infections from bacteria in fecal flora that colonize the perineum.
- Rarely hematological spread (neonates).
- Most common pathogens: **In females**, 75–90% of all infections are caused by ***Escherichia coli***, the remaining are caused by *Klebsiella* and *Proteus*.
- **In males** older than 1 yr of age, *Proteus* is as common as *E. coli*;

PATHOGENESIS

- **others** : gram-positive organisms as (*enterococcus*).. in males.
- *Staphylococcus saprophyticus* is a pathogen in both sexes.
- **Viral** infections, particularly adenovirus may cause cystitis.
- *Pseudomonas spp* is the most common nonenteric gram negative bacteria; may indicate renal tract abnormality.
- Group B Strept is rare and mostly seen in neonatal sepsis

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- *Escherichia coli* - Most common organism; causative agent in > 80% of 1st UTI
 - *Klebsiella* species - 2nd most common organism. Seen more in young infants
 - *Proteus* species - May be more common in males
 - *Enterobacter* species - cause < 2% of UTI's
 - *Pseudomonas* species - cause < 2% of UTI's
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- *Enterococci* species- Uncommon > 30 days of age
- *Coagulase-negative staphylococcus* - Uncommon in childhood
- *Staphylococcus aureus* - Uncommon > 30 days of age
- *Group B streptococci* - Uncommon in childhood

PATHOGENECITY

- THE PATHOGENECITY IS DETERMINED BY bacterial pili or fimbriae on the bacterial surface. There are two types of fimbriae, type I and type II.. The attachment of type II fimbriae is more potent to the uroepithelial cells.
- (*Type II*) *P fimbriae* are expressed by only certain strains of *E. coli* and they are more likely to cause pyelonephritis.
- Between 76–94% of pyelonephritogenic strains of *E. coli* have P fimbriae, compared with 19–23% of the cystitis strains .

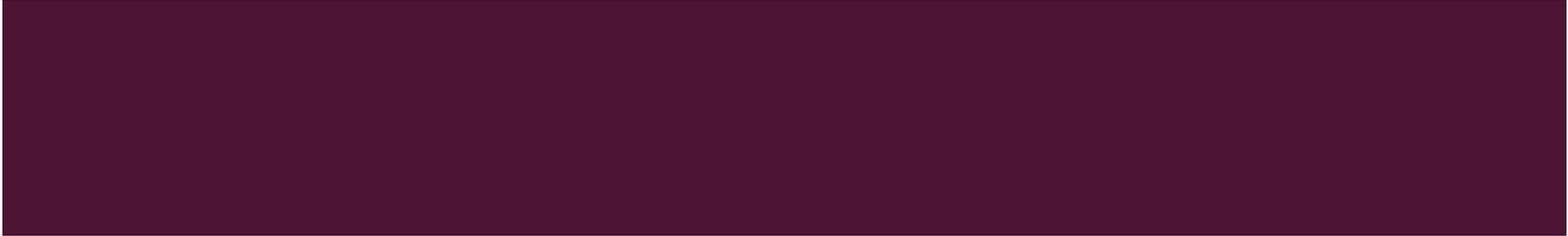
UTI :THE RISK !

The incidence of UTIs varies based on age and sex

- Sex :The prevalence of UTI among febrile infant girls is more than twice that among febrile infant boys
- Uncircumcised boys is 4 -20 times higher
- **first-time symptomatic** UTI are highest in boys during the first year of life and markedly decrease after that while the peak for girls is around 4-5yr age

RISK FACTORS FOR URINARY TRACT INFECTION

Female
Uncircumcised male
Vesicoureteral reflux
Toilet training
Voiding dysfunction
Obstructive uropathy
Urethral instrumentation
Wiping from back to front
Bubble bath
Tight clothing (underwear)
Pinworm infestation
Constipation
P fimbriated bacteria
Anatomic abnormality (e.g., labial adhesion)
Neuropathic bladder
Sexual activity
Pregnancy



Diagnosis

DIAGNOSIS

- The major goal for a pediatrician treating a *febrile young child* is early diagnosis of UTI,
- allow early treatment to preserve the function of the growing kidney by preventing scarring.

DIAGNOSIS

1-Clinical Picture

2-UA (R&M / dip stick)

3- Urine Culture

4- Imaging

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- A UTI may be **suspected** based on :
the symptoms , findings on urinalysis , or both,
but

urine culture is necessary for *confirmation* and appropriate therapy.

- Thus, **the diagnosis of UTI depends** on having the proper sample of urine ..

For URINE CULTURE

OBTAINING A URINE SAMPLE

May be obtained by:

- Bagnot very reliable method
- A mid stream void in a toilet trained child....usually satisfactory
- Catheter or suprapubic sample (SPA)

URINE ANALYSIS

-Dipstick

Blood /Protein/Glucose/pH/S.Gravity /nitrite , leukocyte esterase

-Microscopy

RBC/WBC

epithelial ,tubular cells and casts

NORMAL URINE ANALYSIS

I - Dipstick :

- Blood : presence of Hb

This test is based on the pseudoperoxidase activity of Hb which catalyzes the reaction of tetramethylbenzidine and buffered organic peroxide; The resulting color ranges from greenish-yellow to dark blue.-



DIPSTICK

-False +ve Hb test:

Myoglobinuria

Oxidizing agents contaminating the urine specimen (hypochlorite, povidone)

Heavy bacterial contamination (bacterial peroxidase effect)

-False -ve: reducing substances as ascorbic acid

URINE ANALYSIS

DIPSTICK

-Protein :

Color changes from yellow to green .

Not a quantitative method and affected by concentrated urine .

albumin is detected better than other protein as globulins , tubular proteins

DIPSTICK

Protein In Dipstick :

Trace	0.15g/L
+1	0.3g/L
+2	1.0 g/L
+3	3.0 g/L
+4	20 g/ L

Needs further quantification of protein (24 hr collection and

Up_{prt} / UC_{Cr} ratio if persisted

OTHER ITEMS ON DIPSTICK

- glucose
- pH
- specific gravity

- Nitrite
- Leukocyte esterase

URINE ANALYSIS R&M

2- Microscopy:

-For cells

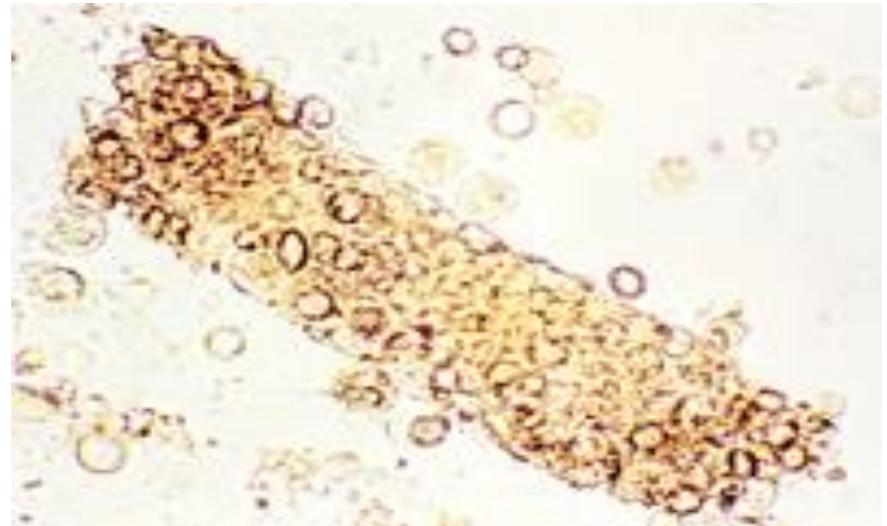
RBC 0-3 RBC/HPF

WBC 0-5 WBC/HPF

-Bacteria

For Cast ; Hyaline cast / epithelial cast,

RBC cast: are always pathological



URINE ANALYSIS ,,,,, INTERPRETATION

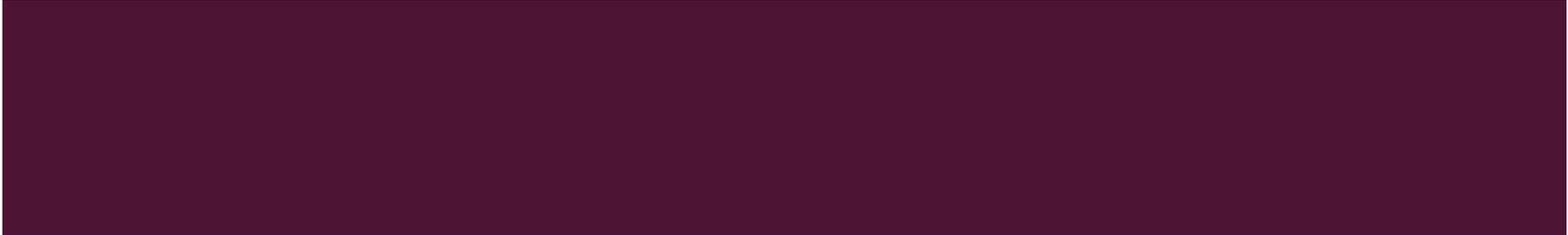
- A urinalysis should be obtained from the same specimen as that cultured.
- Pyuria (leukocytes in the urine) suggests infection, but infection can occur in the absence of pyuria.
- Conversely, pyuria can be present without UTI.
- Nitrites and leukocyte esterase are usually positive in infected urine.
- Microscopic hematuria is common in acute cystitis
- *if the child is symptomatic*, a UTI is possible, even if the urinalysis result is negative

DIAGNOSIS

URINE CULTURE

Positive Urine culture :

- If the urine culture shows greater than 100,000 colonies of a single pathogen
- If there are 10,000 colonies and the child is symptomatic, it is considered a UTI
- **Any** gram negative growth from a *suprapubic sample* is positive culture

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- 
- ***Asymptomatic bacteriuria*** refers to individuals who have a positive urine culture without any manifestations of infection and occurs almost exclusively in girls . It is a benign condition except in pregnancy...

DIAGNOSIS

OTHER LABS

- leukocytosis, neutrophilia, CBC
- elevated erythrocyte sedimentation rate and/or C-reactive protein are common
- Because sepsis is common in pyelonephritis especially in younger children, blood cultures should be taken..

TABLE 1. Sensitivity and Specificity of Components of the Urinalysis, Alone and in Combination (References in Text)

Test	Sensitivity % (Range)	Specificity % (Range)
Leukocyte esterase	83 (67–94)	78 (64–92)
Nitrite	53 (15–82)	98 (90–100)
Leukocyte esterase <i>or</i> nitrite positive	93 (90–100)	72 (58–91)
Microscopy: WBCs	73 (32–100)	81 (45–98)
Microscopy: bacteria	81 (16–99)	83 (11–100)
Leukocyte esterase <i>or</i> nitrite <i>or</i> microscopy positive	99.8 (99–100)	70 (60–92)

DIAGNOSIS

CLINICAL PICTURE

History :

Risk

- Constipation
- Urine retention /dysfunctional voiders
- Enuresis (esp if with day symptoms)
- Family history (UTI or congenital anomalies)
- Antenatal: oligohydramnios/hydronephrosis/

Lung hypoplasia*potter sequence in very young infants*

CLINICAL PICTURE

Physical exam

- Abdomen exam
- Costophrenic (renal angle) tenderness
- Back for sacral dimple or hair tuft
- Lower limbs: tone, power knee reflex

- Check BP
- Check growth parameters

ENURESIS

- ▶ Enuresis :

Is the involuntary voiding of urine at least twice a week for 3 consecutive months in a child older than 5 years.

- ▶ **Primary enuresis:** bedwetting in a child who has never been dry
- ▶ **Secondary enuresis:** a dry period of at least 6 months

TYPES ENURESIS

- ▶ **Nocturnal enuresis:** passing of urine while asleep
- ▶ **Diurnal enuresis :** leakage of urine during the day
- ▶ **Monosymptomatic (uncomplicated) *nocturnal* enuresis:**
normal voiding in the bed at night in the absence of other genitourinary or gastrointestinal symptoms (80%–85% of cases)
- ▶ **Polysymptomatic (complicated) nocturnal enuresis:**
bedwetting associated with daytime symptoms, such as urgency, frequency, urge incontinence, constipation, or encopresis
(5%–10% of cases)
- *a patient with both diurnal and nocturnal enuresis (needs more workup)*

- 
- ▶ Nocturnal enuresis is more common in boys,
 - ▶ Diurnal enuresis is more common in girls

 - ▶ 5% only of cases of nocturnal enuresis are due to organic cause while
 - ▶ ***Diurnal and combined enuresis*** associated with a higher rate of UTIs and with neurologic bladder



TREATMENT

TREATMENT

The goals of treatment a child with UTI:

- Resolution of the acute symptoms of the infection
- Prevention of progressive renal disease by eradication of the bacterial pathogen
- Identification of any urinary tract abnormalities
- Preventing recurrent UTIs

MANAGEMENT ANTIBIOTIC OPTIONS

- Initiating treatment **orally or parenteral is of equal efficacy.**
- the choice of AB agent should be based on local antimicrobial sensitivity patterns and specific pathogen sensitivity
- The clinician should choose 7 - 14 days as the duration of antimicrobial therapy

HOSPITALIZATION & IV TREATMENT

IV treatment and **hospitalization indication**

- Patients whom clinicians judge to be “toxic”
- Or those who are unable to retain oral intake
- for children <3months
- Any child who started oral antibiotics and is still symptomatic or febrile should receive IV A.B

Otherwise most children can be treated orally for pyelonephritis

- Therapy should be 7-14 days (AAP) / or 7-10 days (NICE guidelines).....
- Weather you start oral or IV doesn't matter !

TREATMENT ...CYSTITIS

- **Acute cystitis** should be treated promptly to prevent its possible progression to pyelonephritis, after obtaining culture treatment is started immediately for a **3 to 5-day** course until the urine culture result is back

Antibiotic choices

- with trimethoprim-sulfamethoxazole
- Nitrofurantoin (5–7 mg/kg/24 hr in three to four divided doses)
- Amoxicillin (50 mg/kg/24 hr) is also effective as initial treatment but has no clear advantages over the sulfonamides or nitrofurantoin

ANTIBIOTICS ..PYELONEPHRITIS

either regimen;

- **IV treatment** with 3rd generation cephalosporin like ceftriaxone (rocephin) or Claforan (ciftaxime)
or
- Ampicillin and Aminoglycoside (gentamicin)

-**Oral** third-generation cephalosporins such as cefixime (suprax) are as effective as parenteral ceftriaxone against a variety of gram-negative organisms other than *Pseudomonas*, it is the treatment of choice for oral therapy for pyelonephritis.

ANTIBIOTICS ..PYELONEPHRITIS

- Nitrofurantoin should not be used in children with a febrile UTI because it does not achieve significant renal tissue levels..it is good for cystitis .
- fluoroquinolone *ciprofloxacin* is an alternative agent for resistant microorganisms, particularly *Pseudomonas*, in patients older than 17 yr.

TREATMENT ---COMPLICATIONS

- Renal / perirenal abscess or with infection in obstructed urinary tracts require surgical or percutaneous drainage in addition to antibiotic therapy.

IV CHOICES

Antimicrobial Agent	Dosage
Ceftriaxone	75 mg/kg, every 24 h
Cefotaxime	150 mg/kg per d, divided every 6–8 h
Ceftazidime	100–150 mg/kg per d, divided every 8 h
Gentamicin	7.5 mg/kg per d, divided every 8 h
Tobramycin	5 mg/kg per d, divided every 8 h
Piperacillin	300 mg/kg per d, divided every 6–8 h

ORAL OPTIONS

Antimicrobial Agent	Dosage
Amoxicillin-clavulanate	20–40 mg/kg per d in 3 doses
Sulfonamide	
Trimethoprim-sulfamethoxazole	6–12 mg/kg trimethoprim and 30–60 mg/kg sulfamethoxazole per d in 2 doses
Sulfisoxazole	120–150 mg/kg per d in 4 doses
Cephalosporin	
Cefixime	8 mg/kg per d in 1 dose
Cefpodoxime	10 mg/kg per d in 2 doses
Cefprozil	30 mg/kg per d in 2 doses
Cefuroxime axetil	20–30 mg/kg per d in 2 doses
Cephalexin	50–100 mg/kg per d in 4 doses



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Imaging

IMAGING STUDIES

- The goal of imaging studies in children with a febrile UTI is to identify anatomic abnormalities that predispose to infection. And to identify children who might develop renal injury and scarring

IMAGING

- About 5-10 % of children will develop renal scarring after the first (pyelonephritis) and risk increases more with recurrent uti or presence of VUR
- Up to 50% of children with a febrile UTI will have an anatomical abnormality

RISK SCARRING

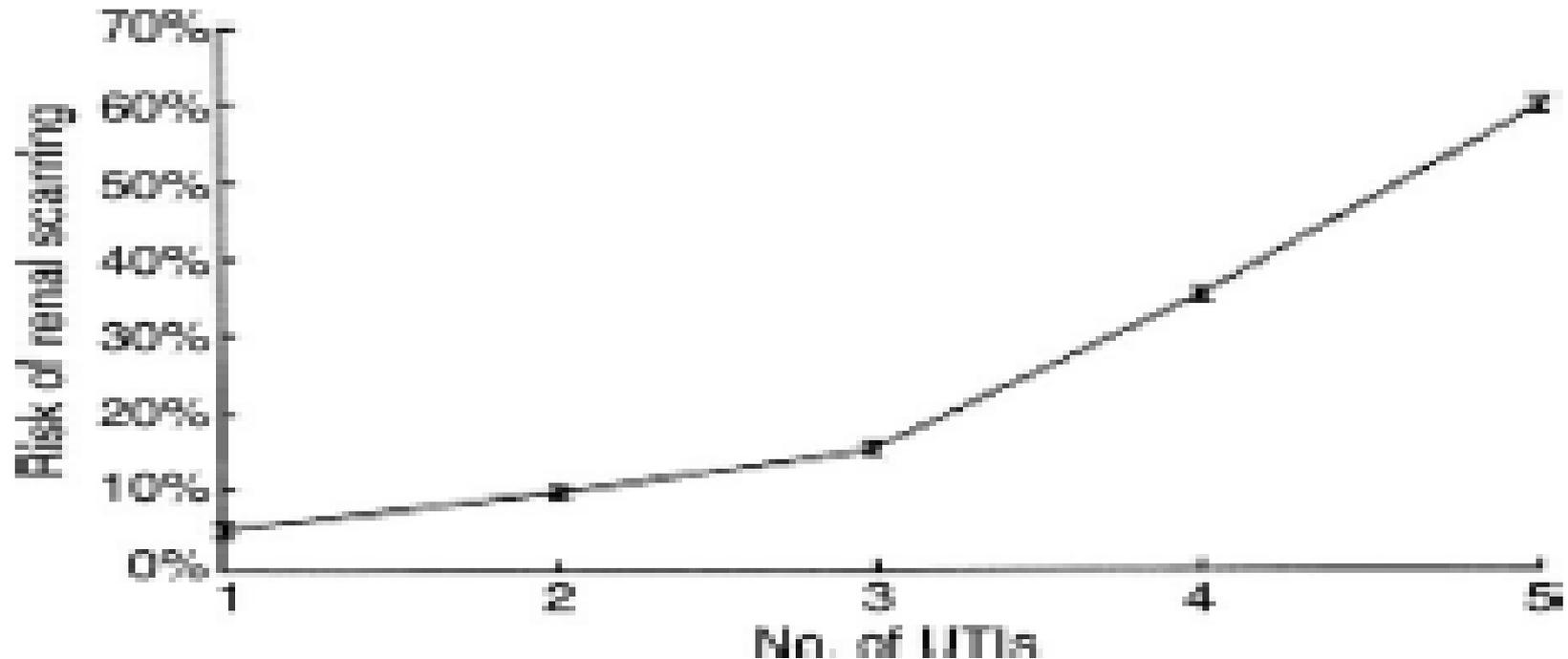


FIGURE 4

Relationship between renal scarring and number of bouts of pyelonephritis. Adapted from Jodal.²⁹

IMAGING TYPES

- Ultrasonography
- VCUG voiding cystourithrogram..
contrast or radionuclide
- DMSA scan (technitium 99 Dimercaptosuccinic acid)

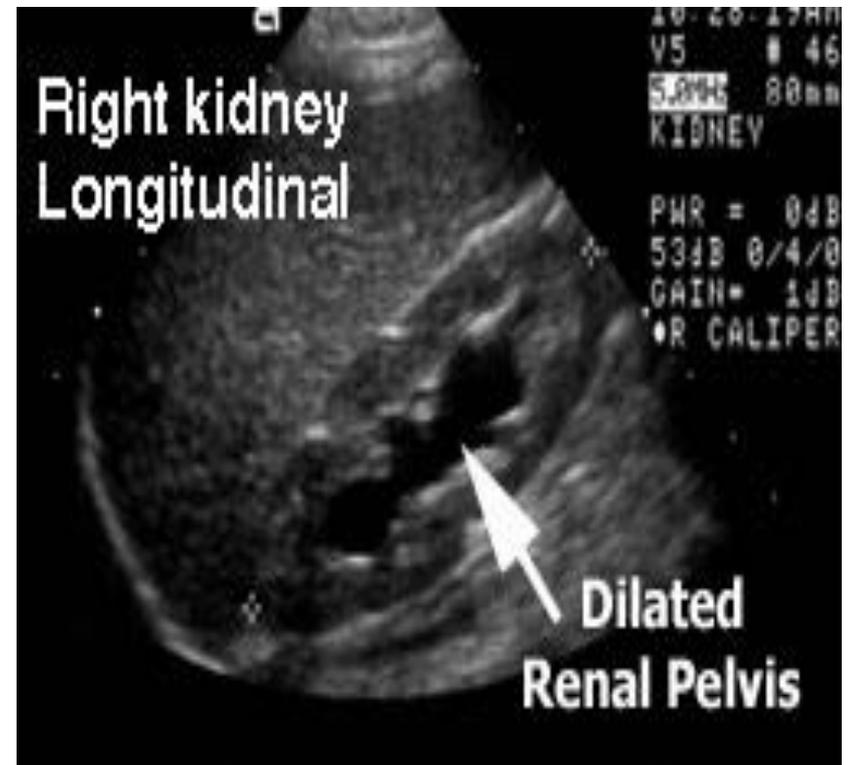
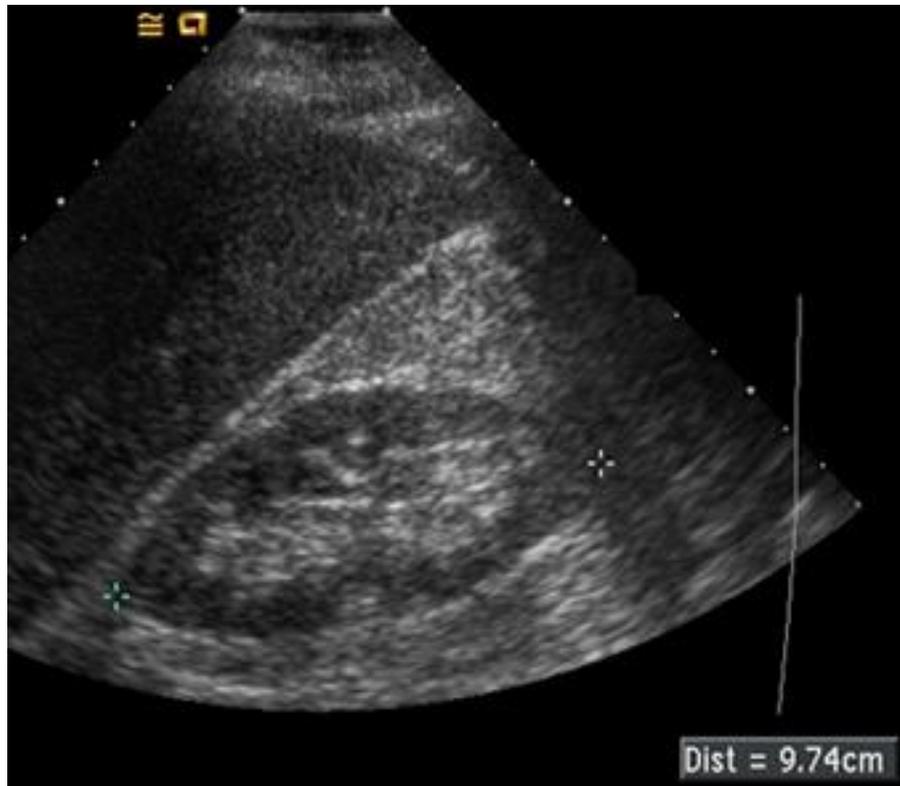
US

- For Every One !
- Is the first standard imaging investigation to be done
- US is recommended during the first 2 days of treatment

- US provides an evaluation of the renal parenchyma , obstruction, hydronephrosis ,corticomedullary differentiation and size that can be used to monitor renal growth
- The main purpose of US is to detect anatomic abnormalities that require further evaluation, (mainly additional imaging) and (VCUG) and urologic consultation

ULTRASOUND

- ultrasonography also may show acute pyelonephritis (in 30–60% of cases) by demonstrating an *enlarged kidney*
- Ultrasonography demonstrates only 30% of renal scars.
- only 40% of children with reflux have any abnormality on the ultrasound



VCUG

- The best investigation to diagnose vesicoureteral reflux VUR
- provide anatomic definition of the bladder, allow precise grading of reflux, demonstrate a paraureteral diverticulum, or show whether reflux is occurring into a duplicated collecting system or an ectopic ureter

VCUG

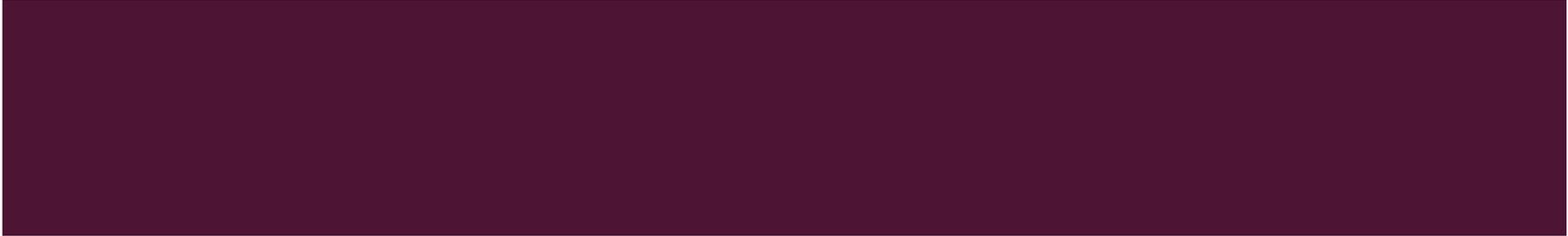
VCUG & FIRST UTI

- Trend has shifted towards not doing VCUG after first UTI !

**VCUG should not be performed routinely after the first febrile UTI;
VCUG is only indicated if :**

- **US reveals hydronephrosis**
- **evidence of scarring on DMSA,**
- **findings that would suggest either high-grade VUR or obstructive uropathy**
- **Atypical UTI infections!**
- **Significant family history of VUR**

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VUR

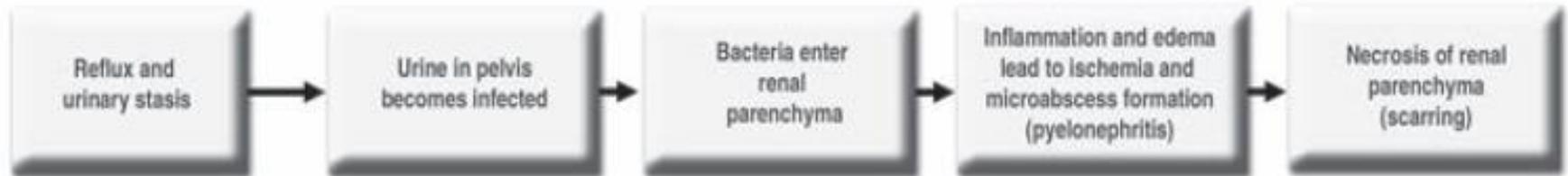
TYPES OF VUR

- primary or secondary .
- **Primary reflux** is a developmental anomaly of the VU junction (ie:VUR in an otherwise normally functioning lower urinary tract),
- **Secondary reflux** is VUR that is associated with or caused by an obstructed lower urinary tract, posterior urethral valves or a neurogenic bladder
- Conditions such as bladder instability can precipitate reflux or worsen pre-existing reflux.



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- Grade I - Reflux into nondilated ureter
 - Grade II - Reflux into renal pelvis and calyces without dilation
 - Grade III - Reflux with mild-to-moderate dilation and minimal blunting of fornices
 - Grade IV - Reflux with moderate ureteral tortuosity and dilation of pelvis and calyces
 - Grade V - Reflux with gross dilation of ureter, pelvis, and calyces, loss of papillary impressions, and ureteral tortuosity

REFLUX NEPHROPATHY



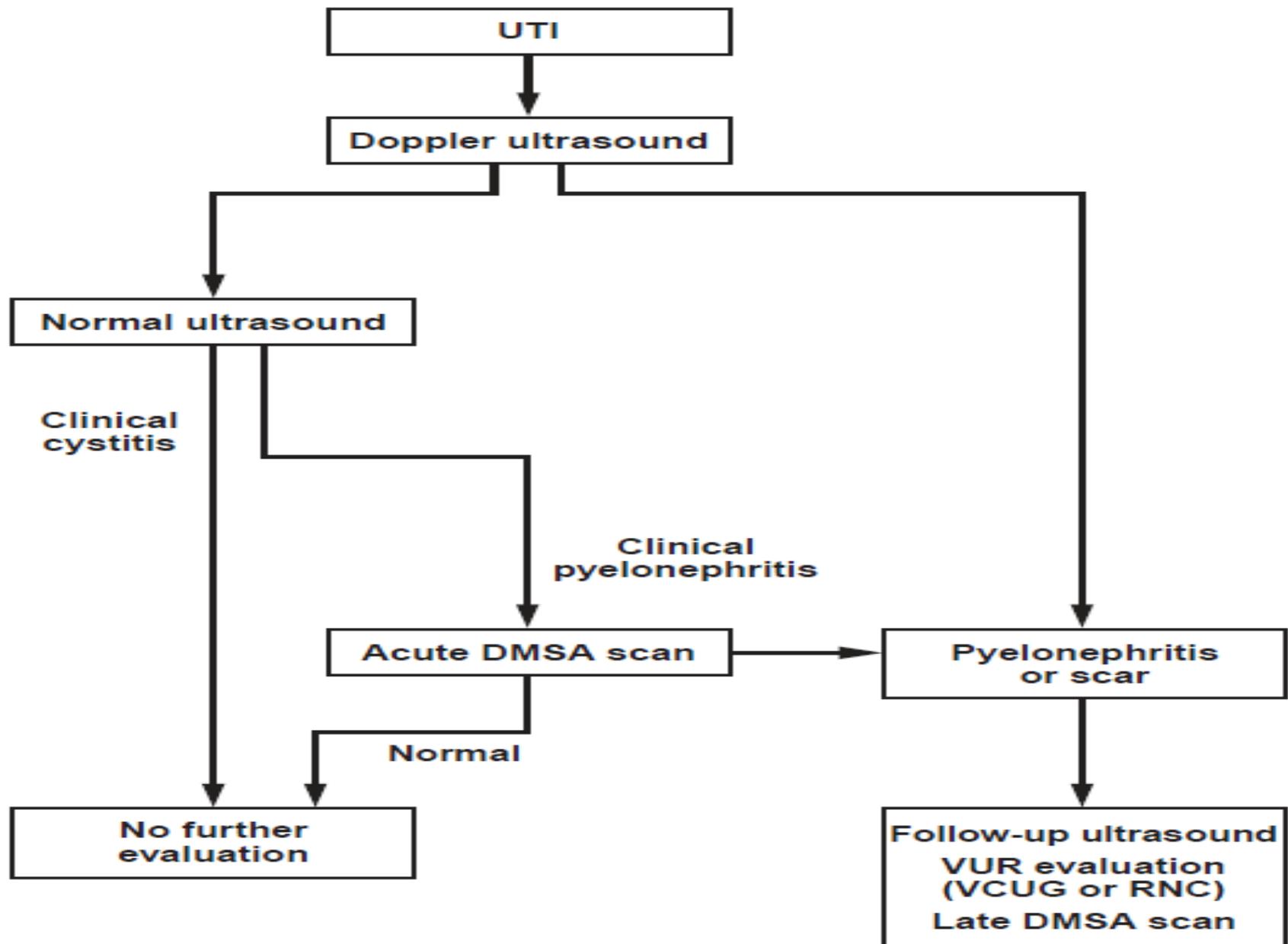
DMSA SCAN

- The DMSA is the most sensitive and accurate study for demonstrating scarring
- If the DMSA scan shows acute pyelonephritis, approximately 50% will acquire a scar in that site over the following 5 mo.
- However, if the DMSA scan is normal during a febrile UTI, no scarring results from that particular infection



- DMSA scans in three children, all imaged from behind, so the left kidney is on the left. (A) A girl presented promptly at 3 months, acutely ill with a UTI. Grade III VUR was identified, but no scarring was present at 17 months. She was monitored closely and remained infection-free on trimethoprim prophylaxis until 4 years of age, and then discharged. She had several UTIs from 6 to 9 years of age, when she had continuing VUR and had acquired severe left renal scarring. (B) A girl was imaged at 5 months because her brother had developed reflux nephropathy. Bilateral VUR was identified without renal scarring. Her parents were consistently non-compliant, and she suffered repeated, prolonged UTIs. A scan at 34 months shows severe left kidney damage, and one at 56 months also showed scars at both poles of her right kidney. (C) A boy had multiple complex congenital abnormalities, including a solitary left kidney with VUR. He remained free of UTIs for over 6 years on prophylaxis, but then suffered several UTIs that were difficult to diagnose, and subsequently acquired scarring.

2007



FOLLOW UP AFTER FEBRILE UTI

- Insure good voiding habit and avoid constipation
- **No need to do routine cultures in healthy asymptomatic children**
- annual US, Urine dipstick and BP check indicated for every child *with renal tract abnormality* .
- Antireflux surgery for high grade VUR with recurrent UTI and continuing renal scarring

PROPHYLAXIS ?

Prophylaxis antibiotics indicated for for:

- recurrent febrile UTI in those with renal tract abnormality and patients with worsening imaging results.

PROPHYLAXIS ANTIBIOTICS

- Prophylaxis options :
 - TMP and SMX(Septra)
 - Nitrofurantoin
 - Nalidixic acid
 - Cephalexin (ultrasporin)

PREVENTION

- Drink large amount of water
- Teaching for dysfunctional voiders
- Children should have access to clean toilet and encouraged to empty bladder
- Treat constipation

CRANBERRIES

- Some evidence suggests that cranberry juice might be beneficial to prevent recurrence of UTI in children



Thank You